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BULLETIN OF THE UNIVERSITY OF WISCONSIN
No. 594; High School Series, No. 12

THE HIGH SCHOOL COURSE IN
AGRICULTURE

BY

K. L. HATCH

Professor of Agricultural Education
The University of Wisconsin

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MADISON
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1913

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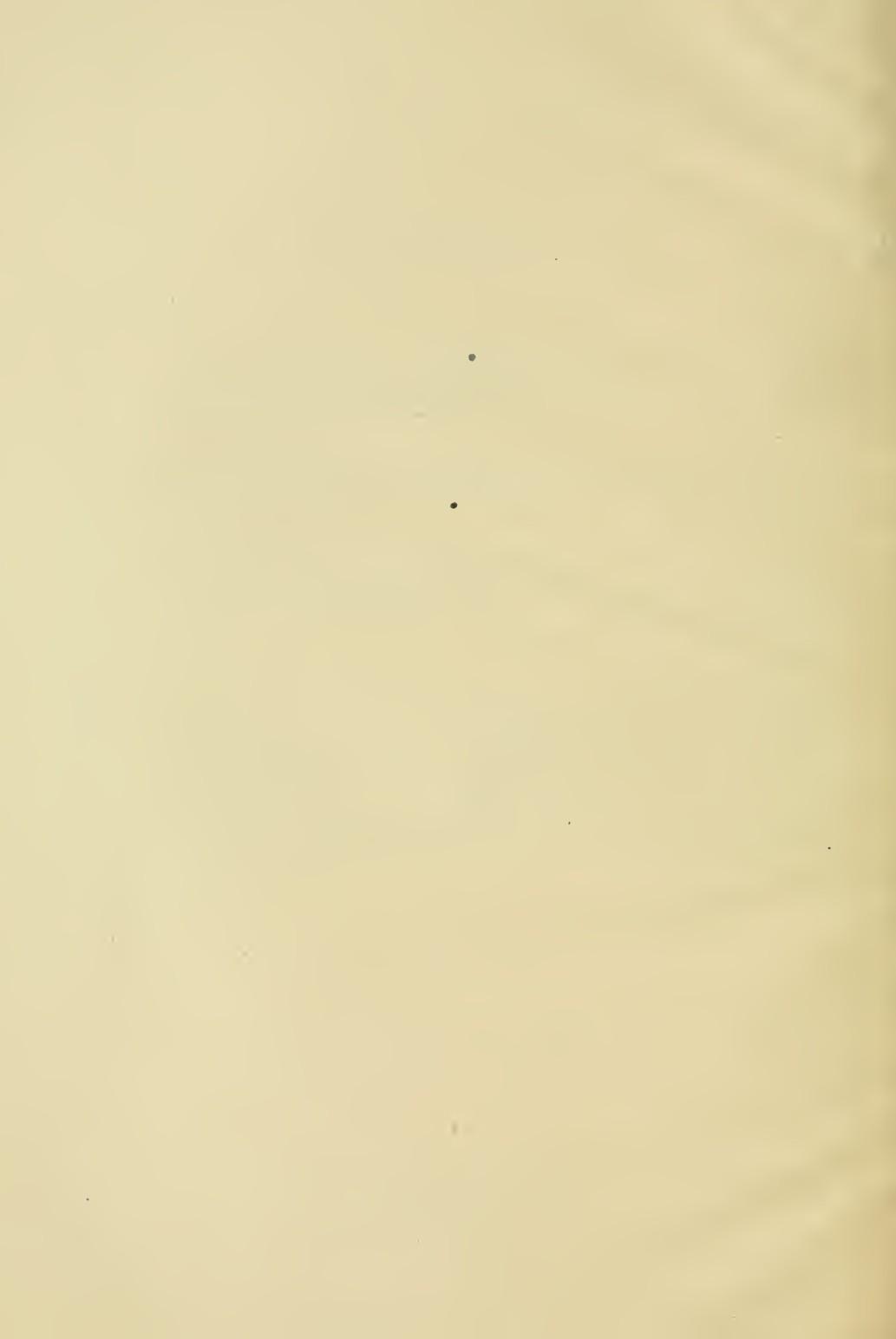
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PREFACE

About fifteen years ago the question of industrial education, including instruction in elementary and secondary agriculture, began to receive serious attention in this state. The matter was earnestly discussed in public meetings, teachers' associations and institutes, educational journals and the daily and weekly press. Finally, a committee was appointed by the state legislature to investigate the subject and report its findings. Acting upon the suggestions of the resultant report, the state legislature in 1901 enacted a law, providing for the establishment of county schools of agriculture and domestic economy and the examination of teachers in elementary agriculture. Four years later the teaching of agriculture in the common schools of the state was made compulsory. Efficient courses were worked out for the county schools and are now being successfully administered in these institutions. Secondary instruction in agriculture has already demonstrated its value as a means of education. The University of Wisconsin has accepted agriculture as fulfilling the requirements for admission and the standing of the subject and its fuller appreciation are assured.

This bulletin has been prepared to suggest suitable plans for the carrying out of this work. The copy has been read by H. L. Terry, State High School Inspector for Wisconsin, and approved by him with the understanding that local conditions and future experience may necessitate a greater or less degree of modification. Correspondence, criticism and suggestions will be welcomed from the teachers who make use of this bulletin. It is earnestly hoped that this instruction may grow to have a larger share in the education of the high school boys and girls in this state, and through them contribute in no small way to the upbuilding and prosperity of the commonwealth.

The writer gratefully acknowledges the valuable assistance of his colleagues in the agricultural college, the members of the University committee on Accredited Schools, and C. S. Hean, College Librarian, in the preparation of material for this bulletin. He is especially indebted to H. L. Terry, High School Inspector for Wisconsin, for reading the manuscript and making valuable suggestions.

SYNOPSIS OF BILL NO. 568, A., LAWS OF 1911 AND 1913

Section 1. Any board having charge of a free high school or a high school having a course of study equivalent (thereto) . . . may establish and maintain . . . a department of manual training, or domestic economy, or agriculture, or any or all of said departments . . . Any school whose course of study or outline of work in manual training, domestic economy, or agriculture, has been approved by the state superintendent, and whose teacher has been qualified may, upon application, be placed upon an approved list of schools . . . (and be entitled to state aid equal to) . . . one-half the amount actually expended for instruction, . . . not, however, to exceed three hundred and fifty dollars for each department established under this act which shall have been maintained in connection with the high school and the two upper grades next below the high school, but not to exceed two hundred and fifty dollars for each department established under this act, which shall have been connected with only the high school.

**GENERAL REQUIREMENTS FOR MANUAL TRAINING,
DOMESTIC SCIENCE, AGRICULTURE AND COM-
MERCIAL SUBJECTS IN ORDER TO SECURE
SPECIAL STATE AID FOR WORK IN
THESE COURSES**

FROM CIRCULAR ISSUED BY STATE DEPARTMENT OF PUBLIC
INSTRUCTION

- "1. The course of study in the high school must be equivalent to the course of study prescribed for free high schools.
- 2. The special course must be approved by the state superintendent.
- 3. The special department must be a part of the public school system; that is, it must be under the direction of the board of education.
- 4. The teacher of any of these special subjects must have a license covering the special work.
- 5. The scope and character of the work must be such as to meet the approval of the state superintendent.
- 6. The work must be maintained for a period of not less than six months during the school year for which aid is granted.
- 7. A report must be made by the clerk of each school board maintaining such department or departments to the state superintendent in such form as may be required, on or before July 1st of each year setting forth facts as stated in the law.
- 8. Chapter 544, laws of 1911, requires that all teachers of such special subjects must receive a salary of at least sixty dollars per month. This applies to grades as well as to high schools.

In order to receive special state aid, for work in grades in these subjects, the law provides:

First, that the grades must be connected with a high school giving the special work and under the management of the same board.

Note:—Town and Union high schools have no grades connected with them even though they may be in the same building. Aid, therefore, cannot be granted to grades under such conditions.

Second, that the work must be given in the two upper grades below the high school.

Third, that it shall be subject to the approval of the state superintendent.

Owing to the fact that work in these subjects in grades is still in an experimental stage, no definite requirements other than those specifically mentioned in the law have as yet been made as a condition for receiving the aid. It is expected, however, that the work shall be in charge of properly qualified teachers, that it shall be definite and systematic, and that a reasonable amount of time shall be given to it each week. At least eighty minutes per week would seem to be a minimum for satisfactory results, and probably a greater amount of time would be better. Many schools now allow more.

The amount of state aid for each of these departments is one-half the cost of instruction in that department, limited to three hundred and fifty dollars when the instruction shall have been given in the high school and the two upper grades next below the high school, or two hundred and fifty dollars when given only in the high school."

SPECIAL REQUIREMENTS AND SUGGESTIONS FOR COURSES IN AGRICULTURE

"Courses in agriculture must, in order to receive approval, provide for at least four full units of the special work.

"It is very desirable that the special teacher of agriculture be employed the entire year rather than for the usual school year. It will then be possible to do actual work as apart of the school courses on pieces of ground on the home farm, on vacant lots in town, or in other ways to give practical applications of what is taught in school. This course will not be considered as being administered in a satisfactory manner unless it includes a very considerable amount of such application. Such work should be done under the careful direction of the teacher and will need his supervision and regular instruction during the summer as well as while the school is in session, if it is to be offered for credit in receiving the special state aid. If work in Agriculture is to be made successful in the high school it must include actual observation and practice and must be linked as closely as possible with the home. As summer is the principal time for farm work, then is when the

teacher can be the most useful, and with a fair sized class his time will be fully occupied in the manner indicated above. In this way, too, it is probable that more practical and satisfactory results can be much more cheaply reached than through a school farm with its heavy care and expense. Some of the leading schools of the state are now employing their teachers for the entire year.

"A good text should be adopted, placed in the hands of the students, and made the basis of the work. Bulletins and other references can then be used to great advantage as supplementary and vitalizing material. Without a text the work is likely to be superficial, indefinite and unsatisfactory. There are now several books on the market which, while intended for only a one-year course, are really extensive enough in their fundamental treatment of different topics so that the single book may be used for two years, or even longer, if outside material is properly used. There is an advantage in the thorough acquaintance with a standard text, which comes from continued use and which is lost in too frequent changes.

"Those responsible for this work in this its formative period, should be constantly on their guard that the work be not made too technical and difficult for high school pupils.

"The injurious effects of this error in the past in nearly all lines of high school work and especially in science are very generally recognized, and it is to be earnestly hoped that the mistake will not be repeated in this new and very desirable subject of agriculture."

WHAT OUGHT TO BE FOUND IN A WELL-ORGANIZED AGRICULTURAL COURSE

There are certain things of a general nature which ought to be found in classes in agriculture as well as in other lines of high school work. The more important of these are as follows:

I. A *teacher* who is master of the fundamental principles of agriculture and in complete sympathy with the work.

II. Pupils interested, attentive and alert; quick in response and ready with questions.

III. Material evidences of well planned, everyday work such as:

1. Note books.
2. Collections of materials.
3. Special apparatus.
4. Charts, maps, pictures.
5. Blackboard outlines.
6. Reference books that give evidence of being used.

Aside from these general observations there are certain special phases of the class room work that should be noted.

Since scientific agriculture is largely applied science, i. e., fundamental facts of science applied to the art of agriculture, we should expect to find the botany class paying some attention to plants of economic importance such as the cereals, the legumes, and the noxious weeds.

In physiology the class may be expected to pay some attention to comparative as well as human physiology and anatomy, and in physical geography the teacher may well lay stress upon the "man-side" of the subject.

In physics we should find emphasis placed on machines and other practical applications of this science, and if a course in chemistry is given we may expect to find the chemistry of plant and animal life receiving especial emphasis.

As to the quality of the training in other lines of work obtained from the study of *agriculture*, the pupils should receive thorough instruction in mathematics, in history, and in English by the frequent application of all these branches to the study. Particular attention should be paid to accurate statement in both oral and written English in connection with all agricultural work.

The Quality and Quantity of Agricultural Instruction

A course in agriculture to be effective should not differ radically in method of treatment from that of any other established course in high school science. Four units of agriculture, on the basis of a sixteen unit course, may be considered a reasonable standard. A unit of agriculture should represent the same amount of time spent in preparation, recitation, and laboratory work as that for a unit of any other science. This will require daily exercises throughout the year.

No attempt should be made to teach agriculture through a distortion of other sciences. Instruction in the fundamental science

should precede or run parallel with the *application* of that science to all agricultural instruction.

General courses in elementary agriculture, composed of portions of each of the four units outlined herein, may well constitute one-half to one unit of work. These general courses are sufficiently outlined in several very satisfactory texts already published and need not, therefore, be discussed here. Where more than one unit of work is to be attempted schools are advised not to separate the units outlined herein by giving fragments of each, but to undertake only as many of them as they can institute in a satisfactory manner.

THE PLACE OF AGRICULTURE IN A HIGH SCHOOL COURSE OF STUDY

The study of agriculture should give to the student a clear understanding of the various forces with which the farmer has to deal. He should become familiar with the laws governing the action of these forces in order to utilize them most efficiently when they act along the line of his progress and to counteract them most effectively when across his path. These forces arrange themselves into three great groups, viz.,—biological, physical, and economic. The principal biological sciences taught in the smaller high schools are botany and physiology; the chief physical science, physics (occasionally chemistry), which with economics (where offered) completes the group of fundamental sciences.

The applications of these sciences are to be found in the four units of agricultural subjects outlined below:

General Outline of Agricultural Units

BIOLOGICAL GROUP

- I. Plant Production, one unit.
- II. Animal Husbandry, one unit.

PHYSICAL GROUP

- III. Agricultural Chemistry and Soils, one unit.

ECONOMIC GROUP

IV. Rural Economics, including Farm Bookkeeping and Management, one unit.

The high school course in agriculture should consist of the four units of work mentioned above arranged in substantially the same order in which they are enumerated.

The introduction of this group of subjects into the program of studies of an already organized high school without disturbing the arrangement of existing courses of study, and at the same time preserving the proper sequence and balance of the agricultural subjects, is a perplexing administrative problem. In cases where the eighth grade is combined with the high school grades or is easily accessible, the following arrangement is suggested:

Eighth Grade—Introductory Science.

Ninth Grade—Plant Production.

Tenth Grade—Animal Husbandry.

Eleventh Grade—Agricultural Chemistry and Soils.

Twelfth Grade—Rural Economics.

Where the above arrangement of work is found impractical the following alternative arrangement is advised:

Suggested Arrangement of Work in Agriculture and Related Sciences for the High School Grades

FIRST YEAR

| | |
|-----------------------|----------------------|
| Introductory Science | Introductory Science |
| Physics, Chemistry | Botany |
| Farm Bookkeeping | Plant Production |
| Accounts | Plant Propagation |
| Records | Gardening |
| Business Transactions | Insects |

SECOND YEAR

| | |
|------------------|-------------|
| Plant Production | Soils |
| Plant Diseases | Soil Study |
| Weeds | Fertilizers |
| Farm Crops | Drainage |

THIRD YEAR

Animal Husbandry

Types and Breeds

Stock Judging

Care and Management

Animal Husbandry

Feeds and Feeding

Dairy Testing

Poultry

FOURTH YEAR

Farm Mechanics

Mechanical Drawing

Farm Buildings

Roads and Bridges

Rural Economics

Production

Exchange and Distribution

Note:—The above arrangement permits of great freedom in the selection of electives, preserves the order of arrangement of agricultural subjects and related sciences, summarizes the work in the study of rural economics and follows, in a general way, the plan adopted by the American Association of Colleges and Experiment Stations. This will be seen by an examination of the course of study outlined by Dr. A. C. True and approved by that association. (See p. 31.)

In this latter arrangement it is necessary to divide the work in chemistry and its various applications to agriculture into two parts and to place the part relating to soils, fertilizers, and drainage so that it may be considered in connection with the study of farm crops. Since the time allotted to plant life study is extended one-half year the study of soils, fertilizers, and drainage during the second year thus becomes easily possible.

It is also necessary to combine the work in feeds and dairy testing with that of animal husbandry. One-half unit of farm mechanics is introduced during the first half of the fourth year, under the assumption that this class of schools will not be provided with a manual training department. In schools where manual training is regularly taught the course in farm mechanics naturally falls into the manual training group of subjects. The amount of time devoted to rural economics is reduced to one-half unit and elementary bookkeeping, suitable for boys and girls alike, introduced during the first year, from which the economic applications must of necessity be omitted. A comparison of this outline with the following, prepared by the State Department of Pub-

lic Instruction "as a suggestive course which may be reduced, added to or otherwise modified to suit local conditions" with the approval of the State Superintendent will reveal their close similarity.

Outline Prepared by the State Department of Public Instruction

FIRST YEAR

| | |
|----------------------------------|--|
| Elementary Physics and Chemistry | Identification of farm garden and wild plants and seeds. Testing of farm and garden seeds Simple Gardening |
|----------------------------------|--|

SECOND YEAR

| | |
|--|---|
| Farm Plant Life | Soils and crops |
| Weeds: Identification, eradication, and seed inspection | Soil formation, physical properties and composition. Fertilizers. |
| Plant diseases: Fungicides | Management of common farm crops of locality. |
| Bacteria in relation to decay, nitrogen fixation, fermentation, disease and common farm practices. | Systems of cropping |
| Corn and grain judging. | Plant propagation. Pruning of trees. |
| Plant breeding. | |

THIRD YEAR

| | |
|-----------------------------------|-----------------------------|
| Farm Animals | Farm Animals |
| Stock judging | Live stock management |
| Breeds and breed characteristics. | Feeds and feeding |
| | Breeding |
| | Simple veterinary practices |
| | Dairy practice |

FOURTH YEAR

| | |
|--|----------------------------|
| Farm Mechanics | Farm Management |
| Farm buildings | Farm and home conveniences |
| Location | |
| Plans | Rural problems, social and |
| Construction | economic |
| Farmyard | |
| Power machinery | |
| Gasoline engine and general farm machinery | |

Condensed Outline of Each Unit of Agricultural Work**PLANT PRODUCTION—ONE UNIT****I. Plant Diseases**

1. Microscopical study of fungus plants
2. Molds, smuts, rusts, blights
3. Other diseases of plants
4. Bacterial diseases of animals

II. Agronomy

1. Corn judging and testing
2. Examining and grading grains
3. Study of weeds
4. Inspection of clovers and grass seeds
5. Study of legumes and forage plants

III. Plant Propagation

1. The use of propagating beds
2. Potting
3. Grafting and budding
4. Rooting cuttings

IV. Gardening

1. Seed testing
2. Hot beds and cold frames
3. Transplanting
4. Outdoor gardening

V. Insects

1. Life histories of insects
2. Collecting and preserving specimens
3. Insects injurious to our fruits and grains
4. Means of controlling ravages of insects

ANIMAL HUSBANDRY—ONE UNIT**I. Types and Breeds of Live Stock**

1. Principles of breeding
2. History of progress made in animal breeding
3. Standard breeds
4. Breed characteristics

II. Stock Judging

1. The "points" on the score card
2. Lantern slide demonstrations
3. Practice in judging stock easily available
4. Visits to best herds in vicinity

III. Care and Management of Live Stock

1. Approved live stock practice
2. Simple principles of veterinary science
3. Live stock sanitation

IV. Poultry

1. Poultry as an economic factor in farm and city life
2. The care and management of poultry
3. Feeding poultry and marketing poultry products
4. Judging poultry

AGRICULTURAL CHEMISTRY AND SOILS—ONE UNIT**I. Dairying**

1. Testing milk and its products for fat
2. Testing for acidity
3. Testing butter for moisture and salt
4. Testing milk for impurities and adulterants

II. Feeds and Feeding

1. Protein and fat and their functions
2. Analyses of feeds
3. Rations and feeding standards

III. Soils and Fertilizers

1. Physical analysis of soils
2. Chemical composition of soils
3. Classification of soils
4. Tillage and inoculation of soils
5. Fertilizing elements of soils
6. Natural fertilizers including legumes
7. Commercial fertilizers
8. Chemical constituents

IV. Drainage

1. Physics of drainage
2. Principles of drainage
3. Methods employed
4. Practice in mapping, ditching, and laying tile

RURAL ECONOMICS, ONE UNIT**I. Production**

1. Economy in production
2. Factors of production
3. The combination of the factors
4. What to produce
5. Types of farming
6. Systems of land tenure

II. Exchange and Distribution

1. The law of supply and demand, under conditions of custom, competition, and monopoly
2. Money, credit, and banking
3. Transportation
4. Methods of distribution
5. Cooperation and concerted action
6. Rent and land values
7. Wages, interest, and taxation

III. Bookkeeping

1. General principles of accounts
2. Keeping of farm accounts
3. Practice in keeping necessary farm records
4. Attention to penmanship, spelling, and general appearance

IV. Business Transactions

1. Making of notes, receipts, bills, etc.
2. Use of weigh bills, bills of sale, etc.
3. Law of contracts
4. Other principles of Commercial Law as applied to farm transactions
5. Combination of enterprises based on records

INTRODUCTORY SCIENCE

The aim of the work in introductory science should be to familiarize pupils with facts, principles and things necessary for an intelligent understanding of the physical and biological forces with which the student has to deal in the study of agriculture. Sufficient instruction in physics, chemistry, and biology should be given to enable the student correctly to interpret the language of agricultural literature.

Exercises should be given on machines, electricity, porosity, solubility, capillarity, osmosis and like phases of physics finding practical application in agriculture. The student should be made familiar with the more important chemical elements and compounds, such as carbon, oxygen, hydrogen, nitrogen, iron, magnesium, sodium, calcium, phosphorus, potassium, sulphur, chlorine, carbon dioxide, lime, soda, ammonia, silica, potash, acids, alkalis, salts, carbohydrates, protein, and fats.

On the biological side stress should be laid on groups of plants of economic importance, such as cereals, legumes, noxious weeds and trees. Students should be made familiar with the names, family characteristics and habits of growth of these plants. How plants live, grow, feed, dispose of waste, and propagate, should receive especial emphasis.

Another phase of biological study should be that of the life histories of insects, their habits and classification. Wherever possible instruction in this branch should be given by the teacher of agriculture and emphasized by demonstration and experiment, the pupils participating.

It is neither necessary nor desirable to classify these exercises under the various sciences to which they belong, the aim being, as has already been pointed out, to familiarize pupils with the common things of the physical and biological world with which they must deal throughout the study of agriculture.

DETAILS OF EACH UNIT OF WORK.**Plant Production****I. PLANT DISEASES:**

This work may well begin with the microscopic examination of bacteria and the spores of a few of the fungous plants. The slides should be prepared and the microscope adjusted by the teacher in charge. This will lead to a study of the ways in which plant diseases and bacterial diseases of animals are disseminated. Molds, smuts, blights, rusts, and rots may each be studied in turn, together with methods of prevention and control. It also will be appropriate to study bovine tuberculosis, the tuberculin test and its method of application. The preparation and use of fungicides and disinfectants should receive attention. (See Duggar's "Fungous Diseases of Plants" or Stevens and Hall's "Diseases of Economic Plants" and Russell and Hasting's "Agricultural Bacteriology".)

II. AGRONOMY:

This course should include corn judging, methods of curing and testing seed corn, the examining and grading of grains and grain judging by use of score cards. Work with forage plants should cover the best methods of seeding, curing and harvesting clover, alfalfa, peas, beans, vetches and other legumes. The grain study should include the seeding, harvesting, and marketing of barley, wheat, oats, speltz, and buckwheat. The study of noxious weeds should consider their characteristics, classification as annuals, biennials and perennials, their habits of growth, and their identification by means of the roots, leaves or seeds of plants. Emphasis should be placed upon the inspection of clover and grass seeds and the identification of the foreign seeds they often contain. (See Hunt's "Cereals in America.")

III. PLANT PROPAGATION:

This study should embrace the morphology of the bean, pea, radish, buckwheat, corn, and beet with special reference to the germination and development of the young plant. Bulbs, corms, tubers and other specialized forms of asexual propagation should be observed and compared with seeds to demonstrate that asexual

means of reproduction are confined almost entirely to plants. The construction and use of the propagating bed, the making of cuttings, the rooting of them in the propagating bed, the transplanting of these to pots and to open ground, and the proper methods to be employed in potting and repotting should receive attention. The various kinds of grafts and grafting wax should be made and much laboratory work done to familiarize the pupils with the methods and practice of plant propagation. (See Bailey's "Nursery Book".)

IV. GARDENING:

The testing of garden seeds should be the first consideration in this course. Seeds showing a low percentage of viability should only be planted for experimental purposes. Practice in the identification of vegetable seeds is also an important part of this work. The construction of hot beds and cold frames should be studied, this apparatus prepared and seeds planted therein. When ready these plants may be transplanted to open ground in the school or home garden and used for further plant life study. The daily recitations should consist of a study of the proper methods of soil tillage and cultivation for the various plants under observation. Home decoration and landscape gardening should receive considerable attention during the course. (See Bailey's "Garden Making".)

V. INSECTS:

This work should begin under the head of Introductory Science with a study of the life histories of a few of the common insects and should include practice in the collection, mounting and preservation of specimens. Insects like the plum curculio and the codling moth such as are injurious to our native fruits should be studied and those that cause serious damage to farm crops should receive due attention. The laboratory work may well include the preparation and application of insecticides. Other means of controlling these pests should be studied. A school collection of injurious insects and examples of their destructive work should be made. (See Comstock's "Insect Life".)

Animal Husbandry

I. TYPES AND BREEDS OF LIVE STOCK:

The work in this subject may well consist of a study of the history of the various breeds and classes of live stock, the methods used to develop these breeds, the distinguishing characteristics of the standard breeds and the special merits of each. This intensive study of animal life in the high school is confronted by special difficulties. If the school is equipped with pictures, charts, a well chosen collection of animal slides and a good lantern these difficulties may be largely overcome. (See Plumb's "Types and Breeds of Farm Animals".)

II. STOCK JUDGING:

The theoretical part of this work should be done in the class room by the use of charts, lantern slides, and the score card. Practice may be obtained from the scoring of individual animals owned in the vicinity of the school or borrowed from more distant breeders. Competitive judging work can be done by occasional visits to the best herds and flocks in the neighborhood. (See Craig's "Stock Judging".)

III. LIVE STOCK CARE AND MANAGEMENT:

A thorough study should be made of the most approved methods of managing flocks and herds with a view to familiarizing the students with the best practice in vogue among practical stockmen and the results obtained by scientific men in their investigations of live stock problems. An effort should be made to correlate this work with the actual practice obtaining in the immediate vicinity of the school in order that a closer relationship may be established between the work of the school and the farm.

In this connection a study of the simpler principles of veterinary science should be made with special reference to sanitation and its place in the prevention of live stock diseases. (See Reynold's "Veterinary Science".)

IV. POULTRY:

A study of poultry easily may be made a part of the high school curriculum. The birds themselves may be brought into the class room. Specimens of each of the leading varieties of chickens may usually be found within easy reach of the school. Pou-

try and its proper feeding, care, and management should be studied as an economic factor in city and rural life. Practice should be given in judging poultry by means of the score card. The best methods to be used in preparing poultry and its products for market should receive attention. (See Robinson's "Poultry Craft".)

Agricultural Chemistry and Soils

I. DAIRYING:

A study of the physical and chemical composition of milk should introduce this branch and be followed by the testing of milk, cream, skimmilk, buttermilk and whey for fat by the use of the Babcock test. The Hart casein test should be demonstrated. The various volumetric tests for acidity should be learned and practiced by actual application in the testing of milk, cream, buttermilk, and whey. Butter and cheese should be tested for salt and moisture by some of the methods in common use. Practice should be given in the testing of milk and its products for impurities and adulterants. (See Farrington's "Testing Milk and Its Products".)

II. FEEDS AND FEEDING:

The composition and value of each of the principal feeds and the compounding of economical and profitable rations are matters of supreme importance in this study and should be given the attention they deserve. The functions of water, protein, carbohydrates, fibre, fats, and ash in feeds should be studied. The chemical relations between the soil, water, air, plants, and animals should be clearly established. Practical feeding demonstrations and experiments should be made at home by pupils who live on farms. Considerable attention should be paid to feeding from the practical standpoint. (See Henry's "Feeds and Feeding" and Hart's "Agricultural Chemistry".)

III. SOILS AND FERTILIZERS:

High school work under this head should follow chiefly physical lines with simple exercises in soil chemistry and fertilizer tests of soils of the neighborhood. These tests may be made either in the greenhouse or in the field. Experiments in soil inoculation should also be made. The influence of the various factors on the movement of soil water and its availability, and the

water holding capacity of soils may be studied. For class room work the origin and chemical composition of soils may be studied and the best methods of tillage discussed. Fertilizer requirements of the various types of soils should be studied. Students should become familiar with the common commercial fertilizers and the source, composition, value, and use of each. (See Whitsom and Walster's "Elements of Soil Fertility" and Vivian's "First Principles of Soil Fertility".)

IV. DRAINAGE:

The influence of soil water and its evaporation on soil temperature should be noted. The general principles of drainage, the movement of drainage waters as influenced by soil structure, slope of land, depth of and distance between ditches and tiles should be carefully studied. Practice should be given in measuring distances and calculating land areas and in mapping small drainage areas by the use of the plane table and otherwise. These maps should show size of the area and the position of tiles. Careful estimates should be made of the cost of drainage of each area mapped. Where practicable, practice should be given in ditching and laying tile. (See Elliott's "Farm Drainage" and Jones' "Notes on Drainage".)

Rural Economics

I. PRODUCTION:

A study of the problems of production should be made with a view to securing economy and efficiency in the use of land, labor, and capital employed in agriculture. The proper combination of farm enterprises, the choice of farm crops and the selection of live stock should be studied with a view to furnishing continuous employment to labor, and securing maximum returns for the land, labor and equipment. This leads to a study of intensity of culture and size of farms and a comparison of diversified with specialized agriculture. All this work should be related to actual conditions obtaining in the immediate vicinity of the school and on the home farms of the pupils living in the country. Unless this relationship is established, instruction in this branch of study is likely to prove sterile and ineffective.

(See Research Bulletin No. 16 of the Wisconsin Experiment Station—"The Place of Economics in Agricultural Education and

Research", by H. C. Taylor; also Bulletin No. 210—"Progress of the Dairy Industry in Wisconsin", by same author.)]

II. EXCHANGE AND DISTRIBUTION:

Students should be made familiar with the law of supply and demand as limited by custom, monopoly and government regulation, and the relation of this law to prices and to the problem of justice in distribution. The influence of good roads and other means of transportation on prices of farm products should receive attention. The place of the middleman in the economy of distribution, direct marketing, buying and selling organizations, coöperation, government regulation and monopoly should be studied in this connection. A constant effort should be made to make this instruction real and vital by relating it to local conditions, drawing illustrations from systems of distribution with which the student is familiar and studying local market problems.

(See Wis. Exp. Sta. Bulletin No. 231—"The Marketing of Wisconsin Cheese", by H. C. Taylor; also "Agricultural Economics" by same author.)

III. BOOKKEEPING:

The general principles of accounts should be studied and practice given in the keeping of farm accounts and necessary records. The practical application of this work will be found in the keeping of farm records quite as much as in a complete set of farm accounts. Hence special stress should be laid on records of value in ascertaining the gross and net returns from the dairy herd, the cultivation of special crops like tobacco, cabbage, and sugar beets, the production of pork and beef, and like special phases of agriculture. Special attention should be paid throughout this course to penmanship, neatness, and accuracy. Slovenly and inaccurate work should not be permitted. (See Roberts' "Farmers' Business Handbook".)

IV. BUSINESS TRANSACTIONS:

Students should be made familiar with ordinary business forms by the writing of notes, receipts, checks, bills, weigh bills, and bills of sale. They should be required to make all necessary computations in connection with these forms and should be made conversant with the law of contracts and certain other phases

of commercial law of interest to farmers. The computation of creamery and cheese factory dividends; the cost and returns from various types of farming; the combination of enterprises in such a manner as to secure maximum returns from land, labor and equipment employed as shown by records kept of various farm operations, especially those of the home farm, should form a part of this course. (See Roberts' "Farmers' Business Handbook".)

THE HOME PROJECT

Instruction in agriculture differs materially from that of any other high school science in that much of the laboratory work must be done outside of school. Unless the theoretical instruction given is carried over into actual practice the work in agriculture will lose much in effectiveness. This condition has given rise to the practice of employing the teacher of agriculture by the calendar rather than by the academic year for the joint purpose of supervising and assisting with home projects by students and coöperating with farmers in local field trial and demonstration work on their own land.

There are three essentials to the success of a home project, viz.,—

- I. Class room study.
- II. Laboratory exercises at school relating thereto.
- III. Home work.

For the purpose of illustration the acre project in corn growing, now being carried out by many schools, is here used.

Brief Suggestive Outline for Home Project in Corn Culture Acre Plot

I. OBJECT:

To secure maximum yield of high quality, cost of production not considered.

II. CLASS ROOM WORK:

A. Preparation of pupils on the following:

1. Desirable soil
2. Fertilizing practices
3. Best preparation of seed bed

4. Selection of seed ears
5. Testing of seed corn
6. Testing of planter to secure uniform stand
7. Methods of cultivation

B. Laboratory Exercises:

1. Making of germination box or tester
2. Making germination tests on individual ears
3. Selection of ears for planting and calculation of germination
4. Testing the planter and calculating stand per hill
5. Calculation of stalks and ears per acre, assuming one ear to the stalk, with percentage of stand as shown by test
6. Determination of average weight of ears and calculation of yield per acre on this basis

NOTE:—The purpose of the above is to familiarize pupils so far as practicable with best agricultural practice in raising corn and to stimulate them to *think* about their work..

III. HOME WORK OF PUPILS:

A. As Individuals

1. Raise an acre of corn
2. Determine accurately the total yield
3. Select a fifty ear sample

B. As a Group

1. Determination of stand by actual count and comparison of same with calculated stand
2. Comparison of actual yield with calculated yield
3. Comparison of actual average weight of ears with calculated weight

IV. WORK OF SCHOOL AND PUPILS:

- A. To conduct a corn contest in which the following points will determine successful contestant
- | | |
|--|-----------|
| 1. Yield per acre..... | 70 points |
| 2. Quality as shown by 50 ear sample... .. | 30 " |
-

| | | |
|-------------|-----|---|
| Total | 100 | " |
|-------------|-----|---|

This project may be repeated or extended to attain the following object:

To Secure Maximum Yield of High Quality at Minimum Cost Per Unit of Production. With this object in view it will be necessary to add instruction in bookkeeping to the above outline and to require the student to keep account of cost and returns in connection with this project. Relative values would then be determined by the following score or one similar thereto.

- | | |
|--|-----------|
| I. Yield per acre..... | 40 points |
| II. Quality as shown by 50 ear sample..... | 30 points |
| III. Cost per unit of production..... | 30 points |

Aside from adequately supplementing the class room instruction, the home project should make such instruction real and vital. It should interest the student in farm life, elevate the business of agriculture, enlist the sympathies of parents and the support of the community and establish that vital relationship between school and home now so popularly demanded.

The possibilities of "the home project idea" are almost unlimited but as yet little developed.

There are three phases to all production projects. Each of the production projects enumerated below may have as its object either of these phases, viz.,—

- I. To secure high quality without reference to yield.
- II. To secure maximum yield of high quality.
- III. To secure maximum yield of high quality at minimum cost per unit of production.

The following list is intended only to be suggestive and is capable of indefinite expansion.

Suggestive List of Home Projects

I. PLANT PRODUCTION:

1. Potato culture, $\frac{1}{4}$ to 1 acre, in potato districts.
2. Alfalfa culture, $\frac{1}{20}$ to $\frac{1}{4}$ acre, on upland soils.
3. Clover growing, $\frac{1}{20}$ to $\frac{1}{4}$ acre, on sandy soils.
4. The production of 1 acre of all the cereals, each in itself a separate project.
5. Establishing an orchard, on the home farm or in fruit region.
6. The culture of $\frac{1}{20}$ to 1 acre of all the truck crops in the vicinity of good markets, each in itself a separate project.

7. The production of a definite area of small fruits, each a separate project.

II. ANIMAL HUSBANDRY:

1. The keeping of feed and milk production records of the home herd.
2. The calculation and feeding of improved rations, with records of results obtained from their use.
3. The care and management of the home herd of cattle, sheep or swine, each in itself a separate project.
4. The care and management of the horses used on the farm.

III. SOIL PROJECTS:

1. Preparation of the land for the farm crops, each in itself a separate project.
2. Soil fertility tests.
3. Fertilizer plot trials.
4. Laying out or installing a drainage project, or both combined.

NECESSARY LABORATORY SUPPLIES FOR CLASS OF TWELVE

| | Estimated Price |
|--|--------------------|
| I. FARM MECHANICS: | |
| 1. *One dozen sets drawing instruments at \$1.50 | \$18.00 |
| 2. One dozen T squares at \$.40..... | 4.80 |
| 3. One blue print frame, home made..... | |
| 4. One dozen drawing boards, home made..... | |
| 5. One dozen 45° triangles | 1.00 |
| 6. One dozen 30°-60° triangles..... | 1.00 |
| | |
| Total | \$24.80 |

* This set should contain a good pen and a pair of good compasses. Pupils may be required to purchase their own drawing instruments.

II. PLANT PRODUCTION:

| | |
|--|-------------|
| 1. One dozen dissecting microscopes at \$1.50.. | \$18.00 |
| 2. One dozen seed corn testers to be made by students | |
| 3. Two dozen tin plates for seed testers at \$1.00 | 2.00 |
| 4. Propagating bed, 2' x 3', home made..... | |
| 5. Hot bed or glass house, home made..... | |
| 6. Cold frame, home made..... | |
| 7. Four dozen 3" pots at .15..... | .60 |
| 8. Four dozen 6" pots at .25..... | 1.00 |
| 9. One dozen grafting knives at .30..... | 3.60 |
| 10. One dozen stretching boards, home made... | |
| 11. One dozen cyanide collecting bottles, home made | |
| 12. Three boxes insect pins—Nos. 1, 3, 6..... | .40 |
| 13. Materials for spraying solutions..... | 1.00 |
| 14. Hand spray pump..... | 2.50 |
| 15. Charts and Riker mounts..... | |
| Total | \$29.10 |

III. ANIMAL HUSBANDRY:

1. Lecture room so screened as to be easily and
quickly darkened
2. Set of animal charts, home made
3. Supply of score cards for the various types of
farm animals, local printer

IV. AGRICULTURAL CHEMISTRY AND SOILS:

| | |
|---|--------|
| 1. One six-bottle Babcock hand tester..... | \$9.00 |
| 2. Supply of extra glassware including skim- milk and cream bottles..... | 3.00 |
| 3. One dozen 100 cc. graduated cylinders at .50 | 6.00 |
| 4. Box Farrington's alkaline test tablets..... | 1.50 |
| 5. One set Torsion balances accurate to .01 gram, with weights..... | 20.00 |
| 6. One dozen common lactometers at .30..... | 3.60 |
| 7. One Benkendorf's moisture test for butter.. | 5.00 |
| 8. One set soil sieves..... | 6.00 |

| | | |
|-----|--|---------|
| 9. | Two bottles sensitive litmus paper, red and blue | .40 |
| 10. | Samples of various commercial fertilizers.. | |
| 11. | Samples of various commercial feeds..... | |
| | Total | \$54.00 |

The above lists comprise the minimum equipment possible for effective instruction in the several units of agricultural subjects. To this should be added at earliest possible convenience the items included in the following lists:

II. FOR PLANT PRODUCTION INSTRUCTION:

| | | |
|----|---|----------|
| 1. | One compound microscope, triple objective $\frac{2}{3}$, $\frac{1}{6}$, $\frac{1}{12}$, Abbe condenser, oil immersion | \$75.00 |
| 2. | One graduated hypodermic syringe..... | 2.50 |
| 3. | One-half dozen clinical thermometers at .75 | 4.50 |
| 4. | Four dozen 3" Petri dishes at \$1.80..... | 7.20 |
| 5. | One dozen hoes at .40..... | 4.80 |
| 6. | One dozen garden rakes at .50..... | 6.00 |
| 7. | Good barrel spray pump..... | 20.00 |
| | Total | \$120.00 |

III. FOR ANIMAL HUSBANDRY INSTRUCTION:

| | | |
|----|---|----------|
| 1. | Good lantern with abundant supply of animal slides | \$100.00 |
| 2. | Incubator and brooder..... | 20.00 |
| 3. | Empire show cooping..... | 10.00 |
| | Total | \$130.00 |

IV. FOR CHEMICAL INSTRUCTION:

| | | |
|----|---|---------|
| 1. | Additional 6 or 8 bottle Babcock hand tester | \$9.00 |
| 2. | One cream scale..... | 6.00 |
| 3. | One-half dozen Quevenne lactometers at \$1.60 | 9.60 |
| | Total | \$24.60 |

**SYLLABUS OF A FOUR-YEAR SECONDARY COURSE IN
AGRICULTURE**

Prepared by the United States Department of Agriculture

REQUIRED SUBJECTS

| Subjects | Units | First year | Second year | Third year | Fourth year | Total hours |
|-----------------------|-------|------------|-------------|------------|-------------|--------------|
| English..... | 3 | 5 | 5 | 3 | 2 | 540 |
| Algebra..... | 1 | 5 | ..... | ..... | ..... | 180 |
| Geometry..... | 1 | ..... | 5 | ..... | ..... | 180 |
| History..... | 1 | ..... | ..... | 2 | 3 | 180 |
| Botany..... | 1 | 5 | ..... | ..... | ..... | 180 |
| Chemistry..... | 1 | ..... | 5 | ..... | ..... | 180 |
| French or German..... | 2 | ..... | ..... | 5 | 5 | 360 |
| Agriculture..... | 4 | 5 | 5 | 5 | 5 | 720 |
| Elective..... | 2 | ..... | ..... | 5 | 5 | 360 |
| Total | | | | | | 2,880 |

ELECTIVE SUBJECTS

| Subjects | Units | Hours per week | Total hours |
|---|-------|----------------------------------|-------------|
| Drawing..... | 1-5 | 1 hour 1 year | 36 |
| Bookkeeping..... | 1-5 | 1 hour 1 year | 36 |
| Civics..... | 2-5 | 2 hours 1 year | 72 |
| Solid Geometry..... | 1-2 | 5 hours $\frac{1}{2}$ year | 90 |
| Plane trigonometry and surveying..... | 4-5 | 2 hours 2 years | 144 |
| French or German..... | 1 | 5 hours 1 year | 180 |
| Botany, chemistry, or physics..... | 1 | 5 hours 1 year | 180 |
| Agriculture, horticulture or elementary forestry..... | ..... | 1 to 5 hours 3d and 4th years | |

REQUIRED SUBJECTS FOR ALL STUDENTS IN AGRICULTURE

| Subjects | Units | First year | Second year | Third year | Fourth year | Total hours |
|---|-------|------------|-------------|------------|-------------|-------------|
| The Plant and its environment | 2-5 | 2 | ..... | ..... | ..... | 72 |
| Farm Crops..... | 1-5 | 1 | ..... | ..... | ..... | 36 |
| Agricultural Engineering..... | 2-5 | 1 | ..... | 1 | ..... | 72 |
| Horticulture and Forestry..... | 1-5 | 1 | ..... | ..... | ..... | 36 |
| Economic Entomology..... | 2-5 | ..... | 2 | ..... | ..... | 72 |
| Animal Husbandry.. | 2-5 | ..... | 2 | ..... | ..... | 72 |
| Dairying..... | 1-5 | ..... | 1 | ..... | ..... | 36 |
| Diseases of Plants and Animals..... | 2-5 | ..... | ..... | 2 | ..... | 72 |
| Farm Management.. | 2-5 | ..... | ..... | ..... | 2 | 72 |
| Subjects to be added from the subjoined list A..... | 1 | ..... | ..... | 2 | 3 | 180 |
| Total..... | ..... | ..... | ..... | ..... | ..... | 720 |

A. SUBJECTS FROM WHICH SELECTION MUST BE MADE TO MAKE UP THE REQUIRED 720 HOURS IN AGRICULTURE

| Subjects. | Hours per week. | | Total hours |
|-------------------------------|-----------------|-------------|-------------|
| | Third year | Fourth year | |
| Farm Crops..... | 2 | 2 | 72 or 144 |
| Animal Husbandry..... | 2 | 2 | 72 or 144 |
| Dairying..... | 2 | 2 | 72 or 144 |
| Horticulture | 2 | ..... | 72 |
| Forestry..... | 2 | ..... | 72 |
| Agricultural Engineering..... | ..... | 2 | 72 |
| Rural Economics..... | 1 | 1 | 36 or 72 |
| Plant Breeding..... | 1 | 2 | 36 or 108 |

LIST OF TEXT AND REFERENCE BOOKS

Prepared by C. S. HEAN, Librarian, College of Agriculture,
Madison, Wis.

I. FARM MECHANICS

The number following the title refers to the publisher in the list of publishers.

| Author | Title | List Price |
|-----------------------|--|---------------|
| King | <i>Ventilation</i> (17) | \$.75 |
| Davidson & Chase..... | <i>Farm Machinery and Farm Motors</i> (3) | 2.00 |
| *Tracy | <i>Introductory Course in Mechanical Drawing</i> (4) | 1.80 |
| *Anthony | <i>Elements of Mechanical Drawing</i> (8) | 1.25 |
| *Bennett | <i>Problems in Mechanical Drawing</i> (30) | 1.20 |
| Brookes | <i>Gas and Oil Engine Handbook</i> (31) | 1.00 |
| *Davidson | <i>Agricultural Engineering</i> (9)..... | 1.50 |

RURAL ECONOMICS

| | | |
|----------------|---|------|
| *Roberts | <i>Farmers' Business Handbook</i> (1) .. | 1.25 |
| *Roberts | <i>The Farmstead</i> (1)..... | 1.50 |
| *Taylor | <i>Agricultural Economics</i> (1)..... | 1.25 |
| Carver | <i>Principles of Rural Economics</i> (2) | 1.60 |
| *Warren | <i>Farm Management</i> (1)..... | 1.75 |
| Coulter | <i>Coöperation Among Farmers</i> (18) . | 1.00 |
| Powell | <i>Coöperation in Agriculture</i> (1).... | 1.50 |
| Green | <i>Law for the American Farmer</i> (1) | 1.50 |
| Willis | <i>Farmers' Manual of Law</i> (3)..... | 2.00 |
| Hays | <i>Farm Development</i> (3)..... | 1.50 |
| Page | <i>Roads, Paths and Bridges</i> (18).... | 1.00 |
| Cooleigh | <i>Handy Farm Devices</i> (3)..... | 1.50 |

II. PLANT PRODUCTION

| | | |
|----------------|---|------|
| *Hunt | <i>Cereals in America</i> (3)..... | 1.75 |
| Spillman | <i>Farm Grasses in the United States</i> (3) | 1.00 |
| Shaw | <i>Soiling Crops and the Silo</i> (3).... | 1.50 |
| Coburn | <i>The Book of Alfalfa</i> (3)..... | 2.00 |
| Wing | <i>Alfalfa Farming in America</i> (15) .. | 2.00 |

*Suitable for texts.

| <i>Author</i> | <i>Title</i> | <i>List Price</i> |
|--------------------------|---|-------------------|
| *Hunt | <i>Forage and Fibre Crops in America</i> | |
| | (3) | 1.75 |
| *Russell & Hastings..... | <i>Agricultural Bacteriology</i> (16).... | 1.25 |
| *Conn | <i>Bacteria, Yeasts and Molds in the Home</i> (2) | 1.20 |
| Bailey | <i>The Forcing Book</i> (1)..... | 1.25 |
| Waugh | <i>The American Apple Orchard</i> (3).. | 1.00 |
| *Duggar | <i>Fungous Diseases of Plants</i> (2)... | 2.00 |
| *Lyon & Montgomery.. | <i>Examining and Grading Grains</i> (2) | .60 |
| *Bailey | <i>Nursery Book</i> (1)..... | 1.50 |
| *Bailey | <i>Garden Making</i> (1)..... | 1.00 |
| Myrick | <i>Book of Corn</i> (3)..... | 1.50 |
| Dondlinger | <i>Book of Wheat</i> (3)..... | \$2.00 |
| Frazer | <i>The Potato</i> (3)..... | .75 |
| Bailey | <i>Principles of Fruit Growing</i> (1).. | 1.50 |
| Bailey | <i>Pruning Book</i> (1)..... | 1.50 |
| Greene | <i>Among School Gardens</i> (24)..... | 1.25 |
| Card | <i>Bush Fruits</i> (1)..... | 1.50 |
| Rawson | <i>Success in Market Gardening</i> (12) | 1.10 |
| Bailey | <i>Principles of Vegetable Gardening</i> | |
| | (1) | 1.25 |
| Taft | <i>Greenhouse Construction</i> (3)..... | 1.50 |
| Taft | <i>Greenhouse Management</i> (3)..... | 1.50 |
| Bailey | <i>Plant Breeding</i> (1)..... | 1.25 |
| Bennett | <i>The Flower Garden</i> (12)..... | 1.50 |
| Maynard | <i>Landscape Gardening</i> (10)..... | 1.50 |
| Bailey | <i>Manual of Gardening</i> (1)..... | 2.00 |
| Lodeman | <i>Spraying of Plants</i> (1)..... | 1.25 |
| *Stevens & Hall..... | <i>Diseases of Economic Plants</i> (1) .. | 2.00 |
| Weed | <i>Farm Friends and Farm Foes</i> (8). | .90 |
| Lipman | <i>Bacteria in Relation to Country Life</i> | |
| | (1) | 1.50 |
| *Goff | <i>Principles of Plant Culture</i> (14)... | 1.00 |
| Wing | <i>Meadows and Pastures</i> (15)..... | 1.50 |
| Waugh | <i>Beginner's Guide to Fruit Growing</i> | |
| | (3) | .75 |
| Grubb & Guilford..... | <i>The Potato</i> (12)..... | 2.00 |
| *Watts | <i>Vegetable Gardening</i> (3)..... | 1.75 |
| *Wilson & Warburton.. | <i>Field Crops</i> (9)..... | 1.50 |
| Burkett | <i>Farm Crops</i> (3)..... | 1.50 |
| Moore | <i>Practical Orcharding on Rough Lands</i> (32) | 1.50 |
| Sevey | <i>Peas and Pea Culture</i> (3)..... | .50 |
| Troop | <i>Melon Culture</i> (3)..... | .50 |
| Tracy | <i>Tomato Culture</i> (3)..... | .50 |
| Pammel | <i>Weeds of the Farm and Garden</i> (3) | 1.50 |

III. ANIMAL HUSBANDRY

| | | |
|------------------|--|------------|
| Smith | <i>Our Insect Friends and Enemies</i> | |
| | (11) | 1.50 |
| *Plumb | <i>Types and Breeds of Farm Animals</i> | |
| | (2) | 2.00 |
| Punnett | <i>Mendelism</i> (1) | (about).80 |
| Davenport | <i>Domesticated Animals and Plants</i> | - |
| | (2) | 1.25 |
| Doncaster | <i>Heredity</i> (23) | .40 |
| Wing | <i>Sheep Farming in America</i> (15) .. | 1.00 |
| Roberts | <i>The Horse</i> (1) | 1.25 |
| Johnstone | <i>The Horse Book</i> (15) | 2.00 |
| Coburn | <i>Swine in America</i> (3) | 2.50 |
| Craig | <i>Diseases of Swine</i> (3) | .75 |
| Mayo | <i>Diseases of Animals</i> (1) | 1.50 |
| Reynolds | <i>Veterinary Studies</i> (1) | 1.75 |
| Salmon | <i>Diseases of Poultry</i> (3) | .50 |
| Mumford | <i>Beef Production</i> (29) | 1.50 |
| Bach | <i>How to Judge a Horse</i> (5) | 1.00 |
| Wilcox | <i>Farm Animals</i> (12) | 2.00 |
| Shaw | <i>Management and Feeding of Cattle</i> | |
| | (3) | 2.00 |
| *Decker | <i>Cheese Making</i> (14) | 1.75 |
| *Brigham | <i>Progressive Poultry Culture</i> (28) .. | 1.50 |
| *Craig | <i>Judging Live Stock</i> (26) | 1.50 |
| *Comstock | <i>Insect Life</i> (27) | 1.75 |
| *Hawks | <i>Science and Art of Poultry Culture</i> | |
| | (22) | 2.75 |
| *Plumb | <i>Beginnings in Animal Husbandry</i> | |
| | (9) | 1.25 |
| Langstroth | <i>On the Hive and Honey Bee</i> (33) .. | 1.00 |
| Marshall | <i>Breeding Farm Animals</i> (15) | 1.50 |
| Kleinheinz | <i>Sheep Management</i> (20) | 1.50 |
| Dawson | <i>The Hog Book</i> (15) | 1.50 |
| *Robinson | <i>Principles and Practice of Poultry</i> | |
| | <i>Culture</i> (2) | 2.50 |
| Valentine | <i>The Beginner in Poultry</i> (1) | 1.50 |
| Eckles | <i>Dairy Cattle and Milk Production</i> | |
| | (1) | 1.50 |
| Harper | <i>Manual of Farm Animals</i> (1) | 2.00 |
| Burkett | <i>First Principles of Feeding Farm</i> | |
| | <i>Animals</i> (3) | 1.50 |
| Sanderson | <i>Insect Pests of Farm, Garden and</i> | |
| | <i>Orchard</i> (10) | 3.00 |
| *Henry | <i>Feeds and Feeding</i> (13) | 2.25 |
| *Jordan | <i>Feeding of Animals</i> (1) | 1.50 |
| Shaw | <i>Feeding of Farm Animals</i> (3) | 2.00 |
| Gurler | <i>The Farm Dairy</i> (15) | 1.00 |
| Lane | <i>The Business of Dairying</i> (3) | 1.25 |

IV. AGRICULTURAL CHEMISTRY AND SOILS

| | | |
|------------------------|---|------|
| *King | <i>The Soil</i> (1)..... | 1.50 |
| *Vivian | <i>First Principles of Soil Fertility</i> (3) | 1.00 |
| *Burkett | <i>Soils</i> (3) | 1.25 |
| Storer | <i>Agriculture in Some of Its Relations</i> with Chemistry, 3 vols. (6)..... | 5.00 |
| Warrington | <i>Chemistry of the Farm</i> (3)..... | 1.00 |
| *Hart & Tottingham.. | <i>Agricultural Chemistry</i> (7)..... | 1.50 |
| Vorhees | <i>Fertilizers</i> (1) | 1.25 |
| Hall | <i>Fertilizers and Manures</i> (19)..... | 1.50 |
| *Snyder | <i>Soils and Fertilizers</i> (1)..... | 1.25 |
| King | <i>Irrigation and Drainage</i> (1)..... | 1.50 |
| *Farrington & Woll.... | <i>Testing Milk and Its Products</i> (14) | 1.00 |
| Wing | <i>Milk and Its Products</i> (1)..... | 1.50 |
| *Lyon & Fippin..... | <i>Principles of Soil Management</i> (1) | 1.75 |
| *Russell & Hastings.. | <i>Experimental Dairy Bacteriology</i> (2) | 1.00 |
| Conn | <i>Practical Dairy Bacteriology</i> (3).. | 1.25 |
| *Kahlenberg & Hart... | <i>Chemistry and Its Relations to</i> <i>Daily Life</i> (1)..... | 1.25 |
| Hall | <i>The Feeding of Crops and Stock</i> (19) | 1.50 |
| Johnson | <i>How Crops Feed</i> (3)..... | 1.50 |
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